



Decrease in Sapling Nutrient Concentrations for Six northern Rocky Mountain Coniferous Species

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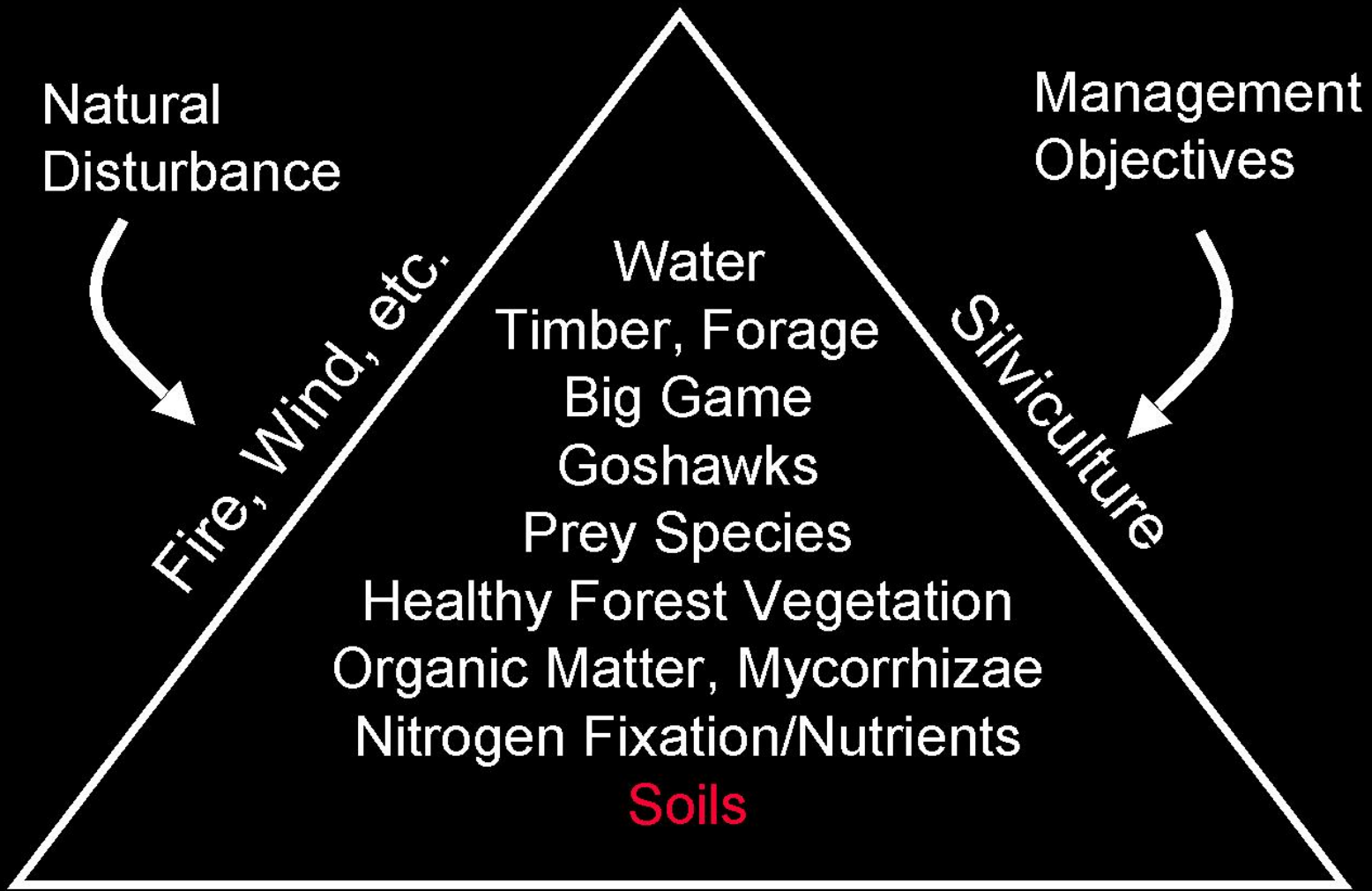
Moscow, ID 83843

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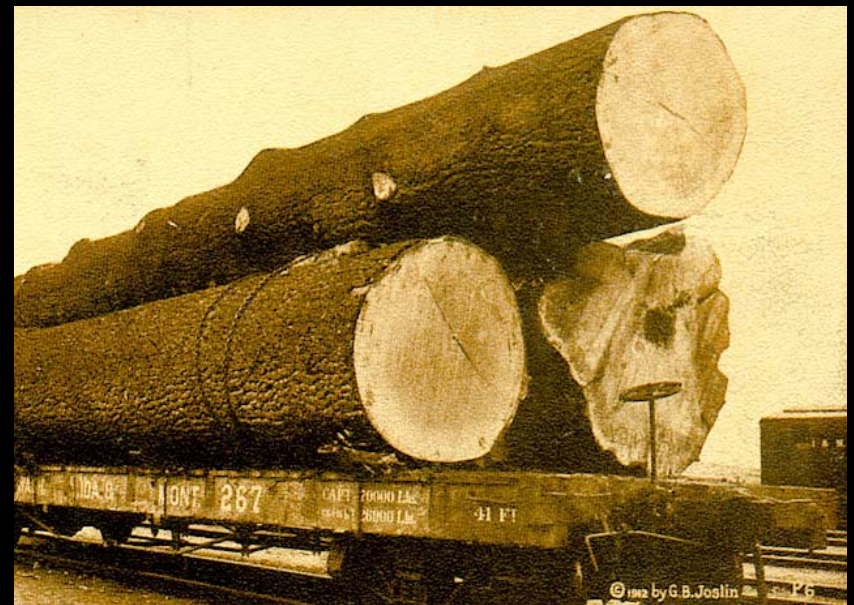
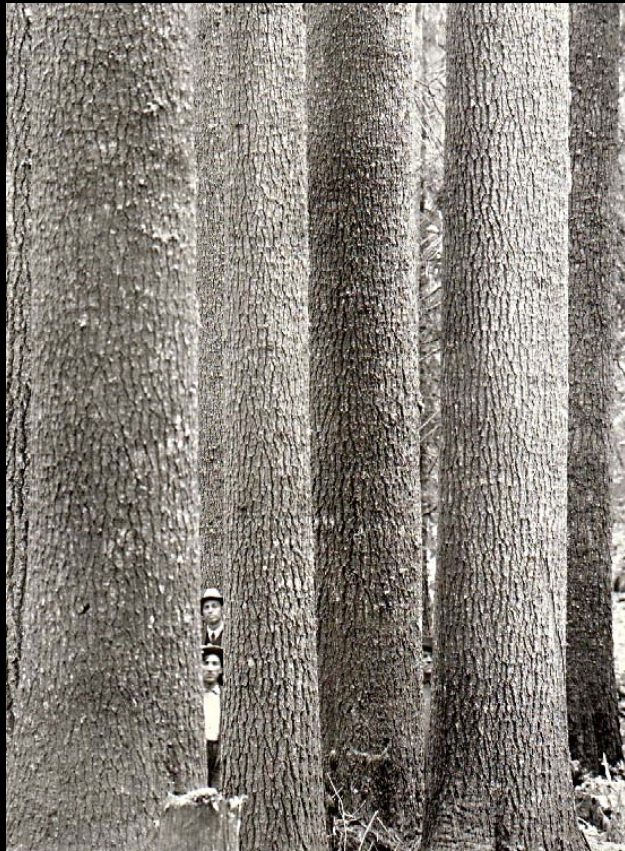
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Soil Productivity



Large Wood Forest Biomass Removal Not New



Treating biomass



Grapple piling



Mastication



Use for biofuel

What factors influence our decision?



Prescribed fire

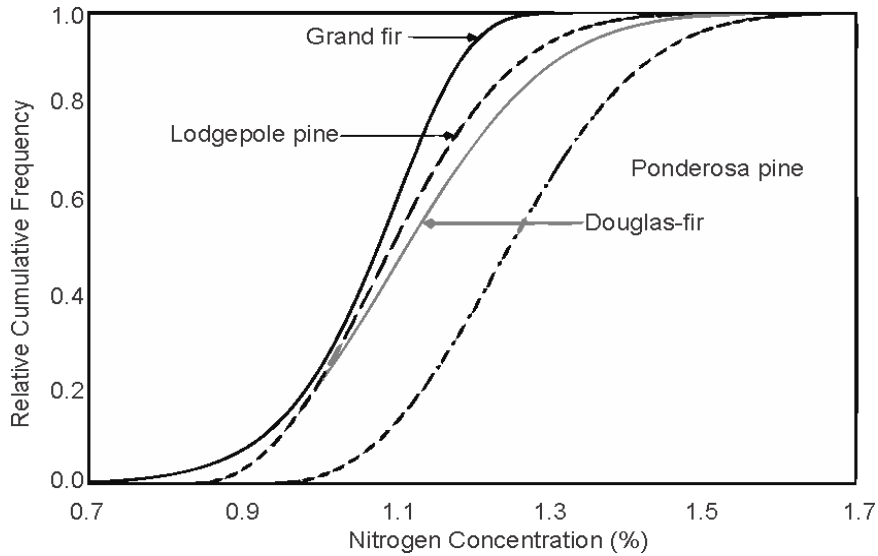
Question

What is the balance
between biomass removal
versus
leaving enough material to
ensure sustainability of the resource
or
consider other alternatives?

Intermountain Forest Tree Nutrition Cooperative

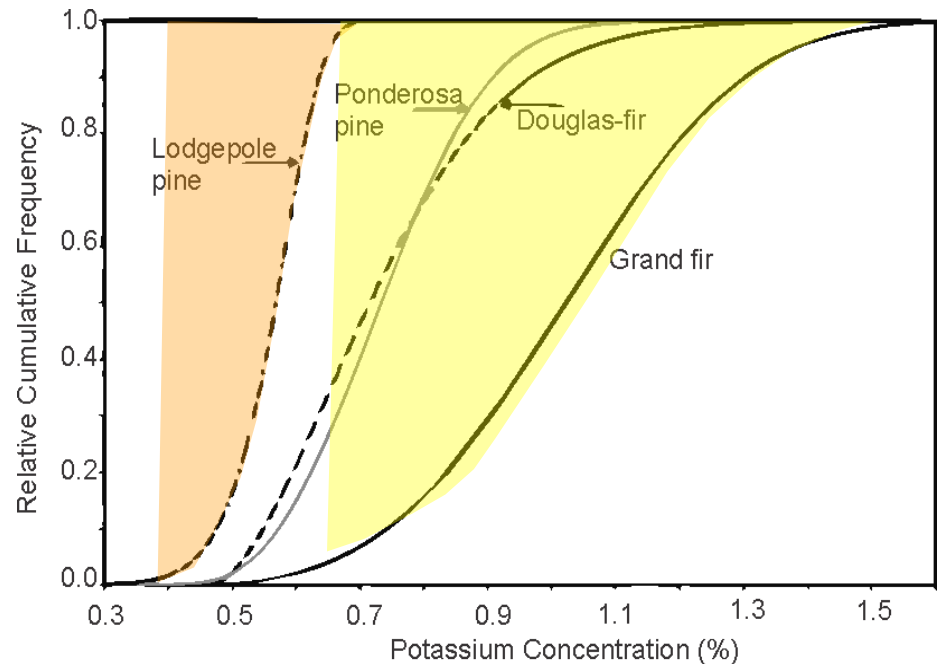


Among Species Across Sites



But not within
sites....

Moore et al. 2004



Looking Forward 50 Years



Managing grand fir

Shorter rotations

Potential biofuel markets

Biomass is like the wind



Finland/Sweden Biofuel

56% decline in growth (4-year period)

8 to 13% decrease in annual growth over 10 years

Jacobson et al. 2000

Helmisaari et al. 2011

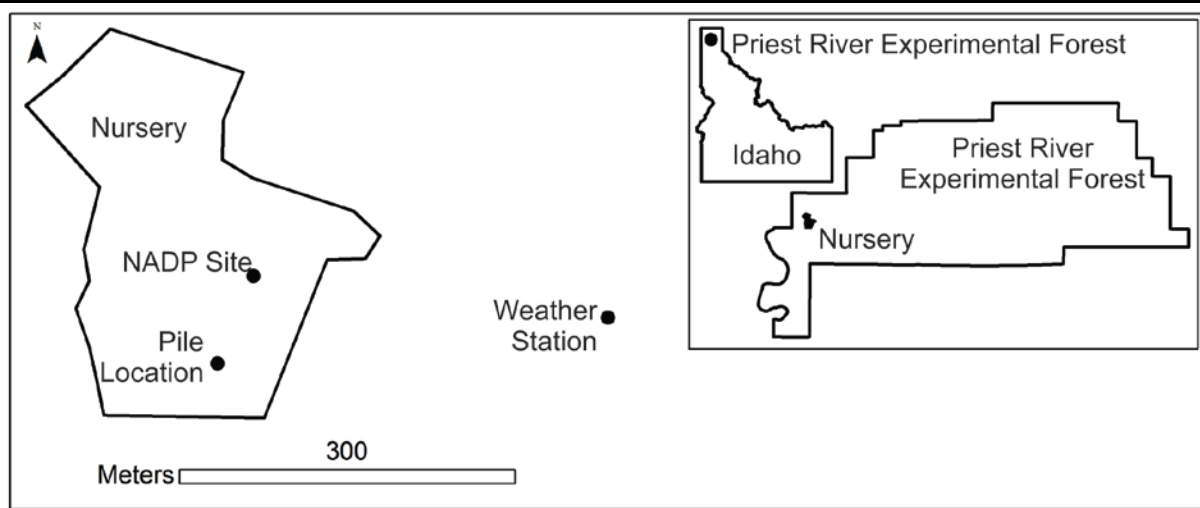


Two Questions

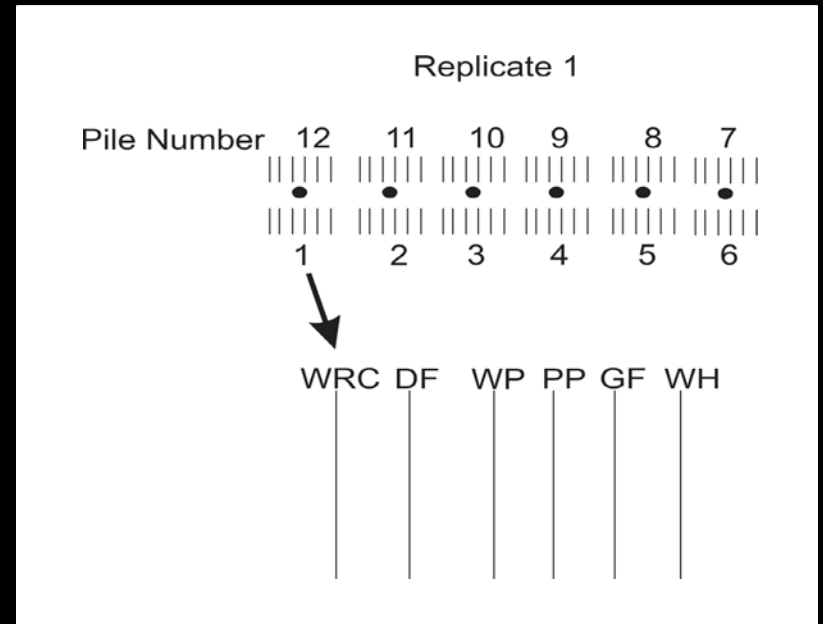
What is the variation in nutrient concentrations on a given site among species?

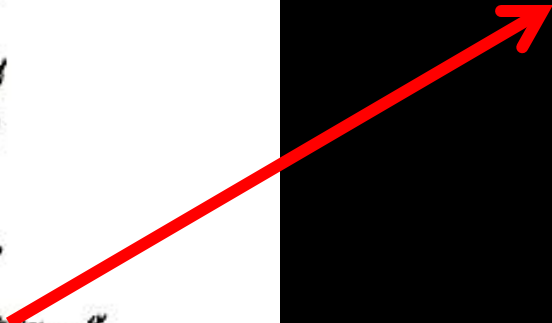
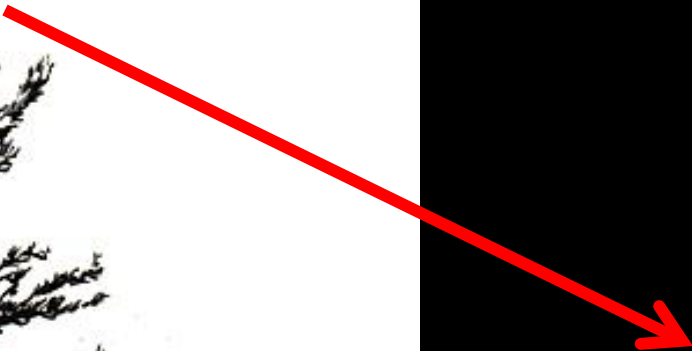
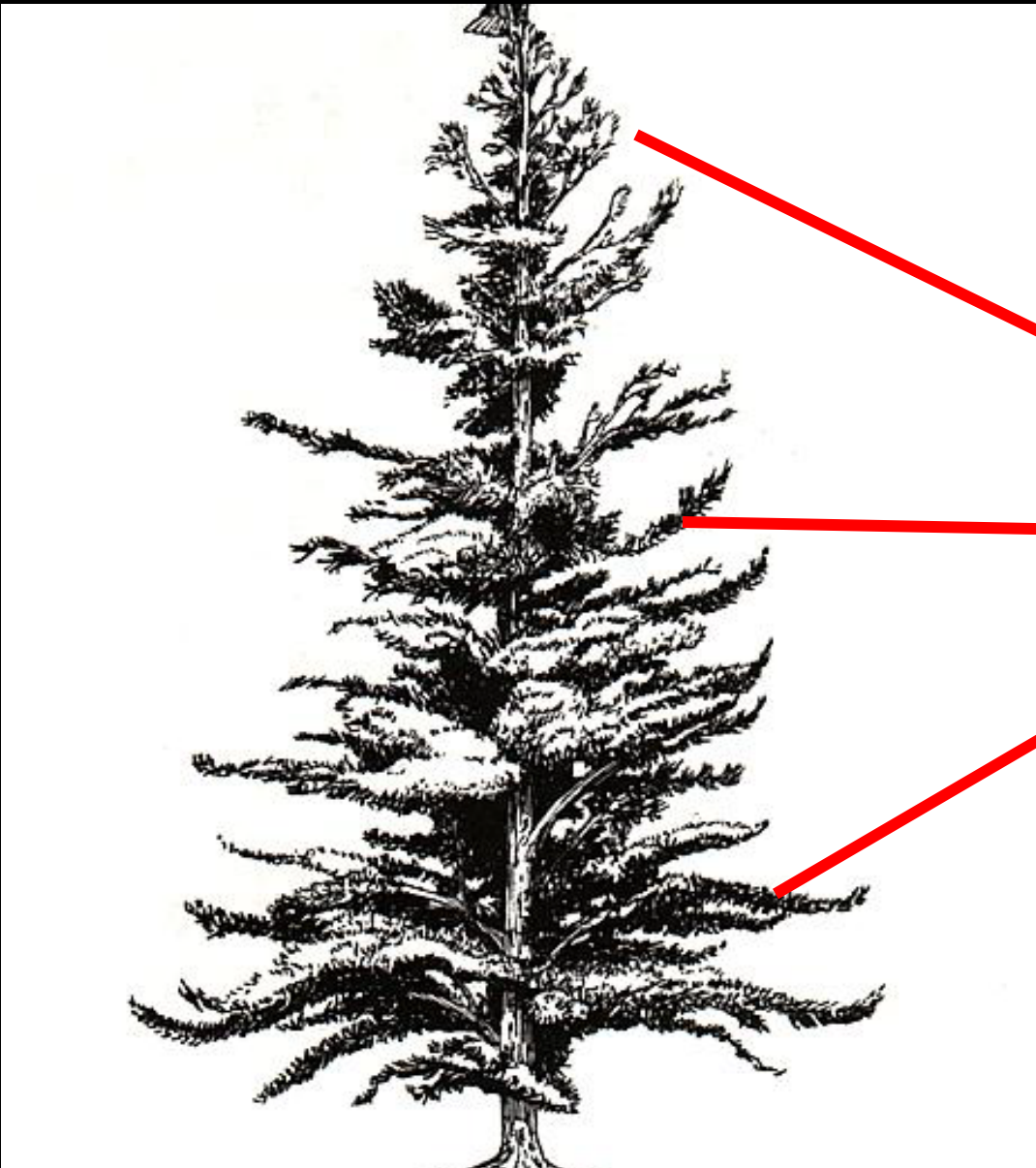
How do nutrient concentrations change by species over a 1-year period?

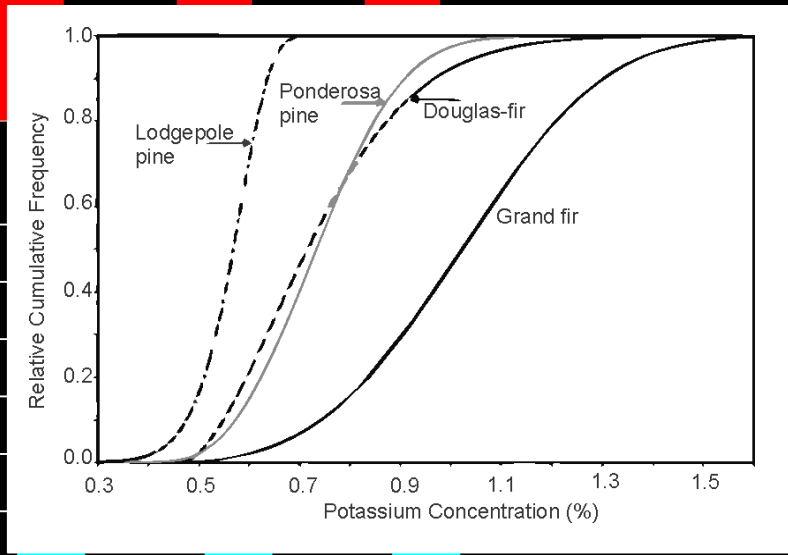
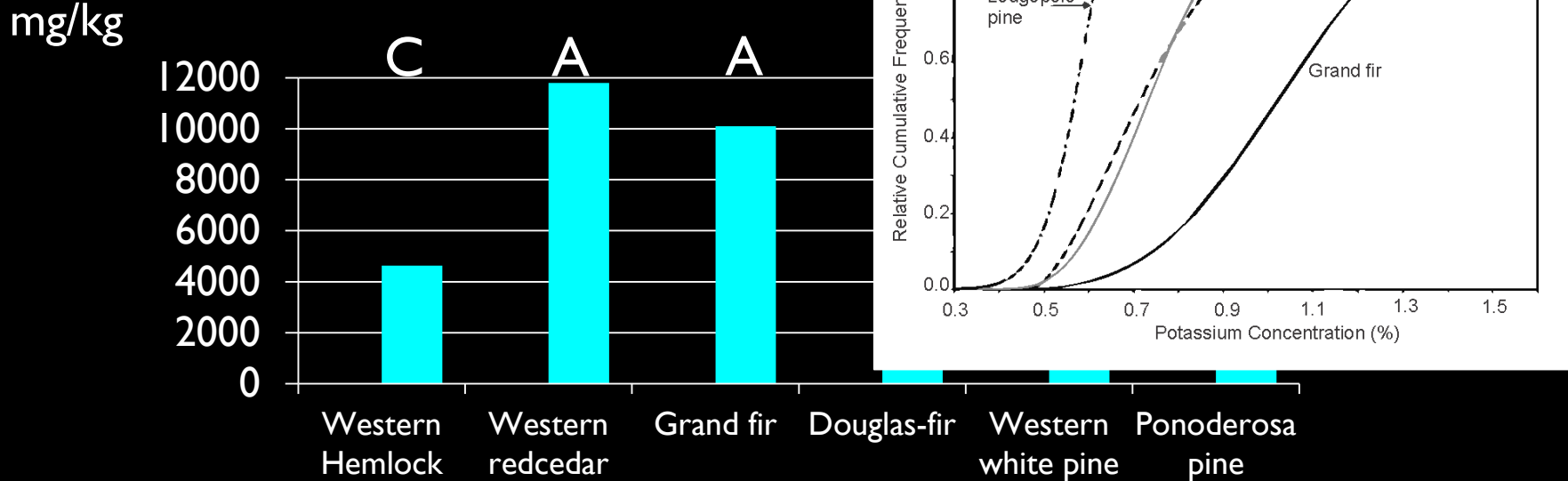
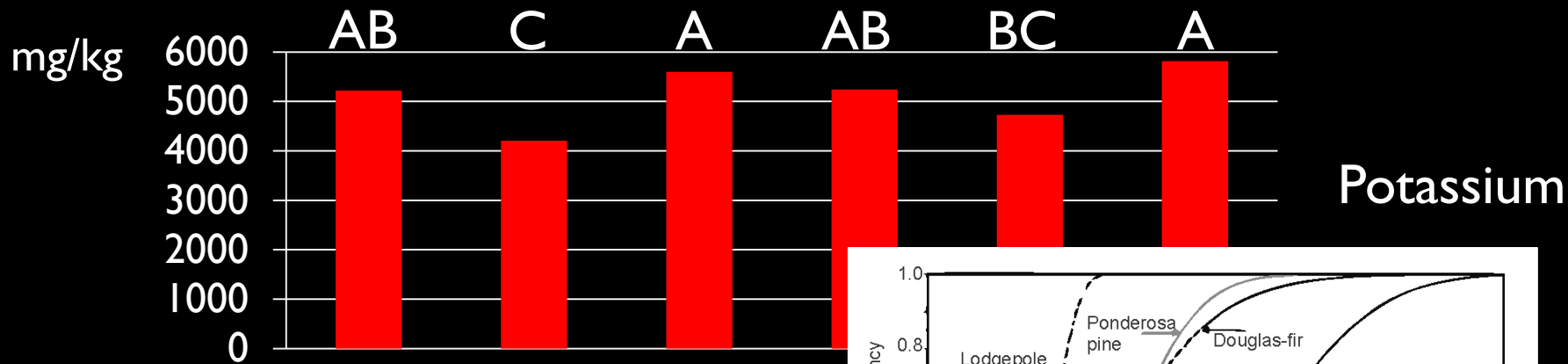
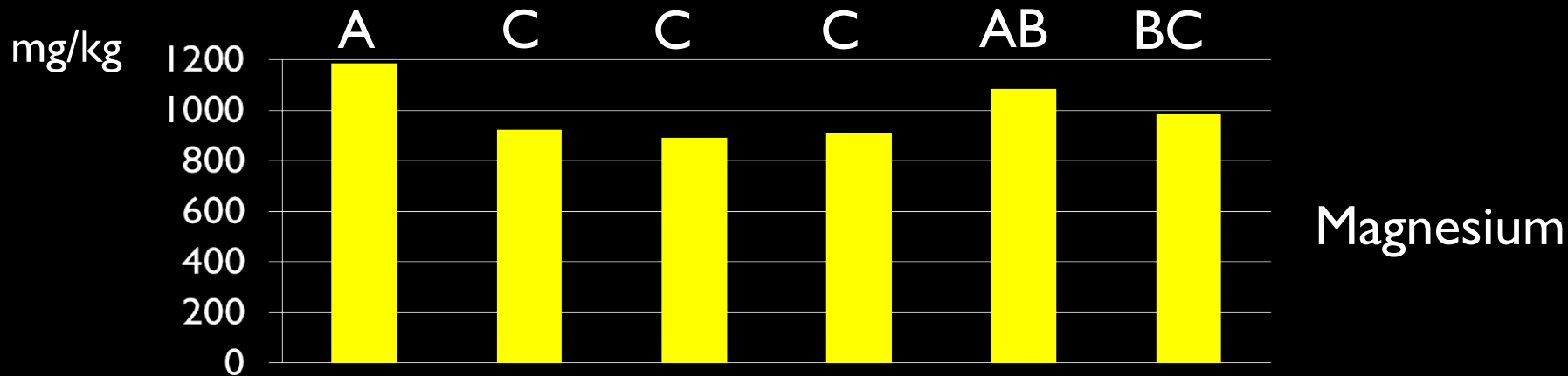
Nutrient Leaching

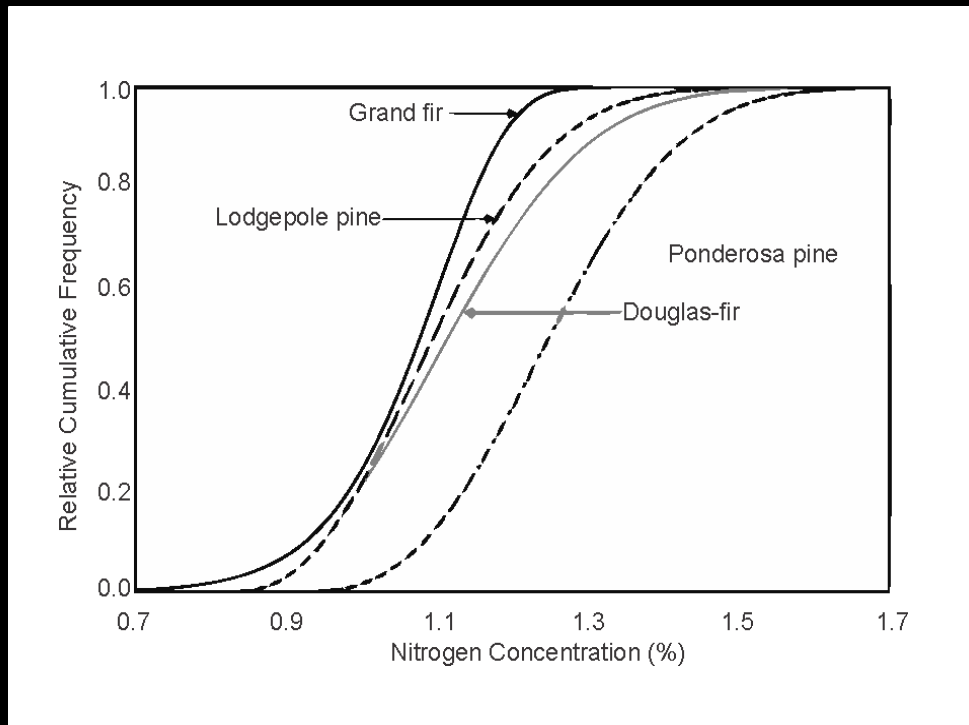
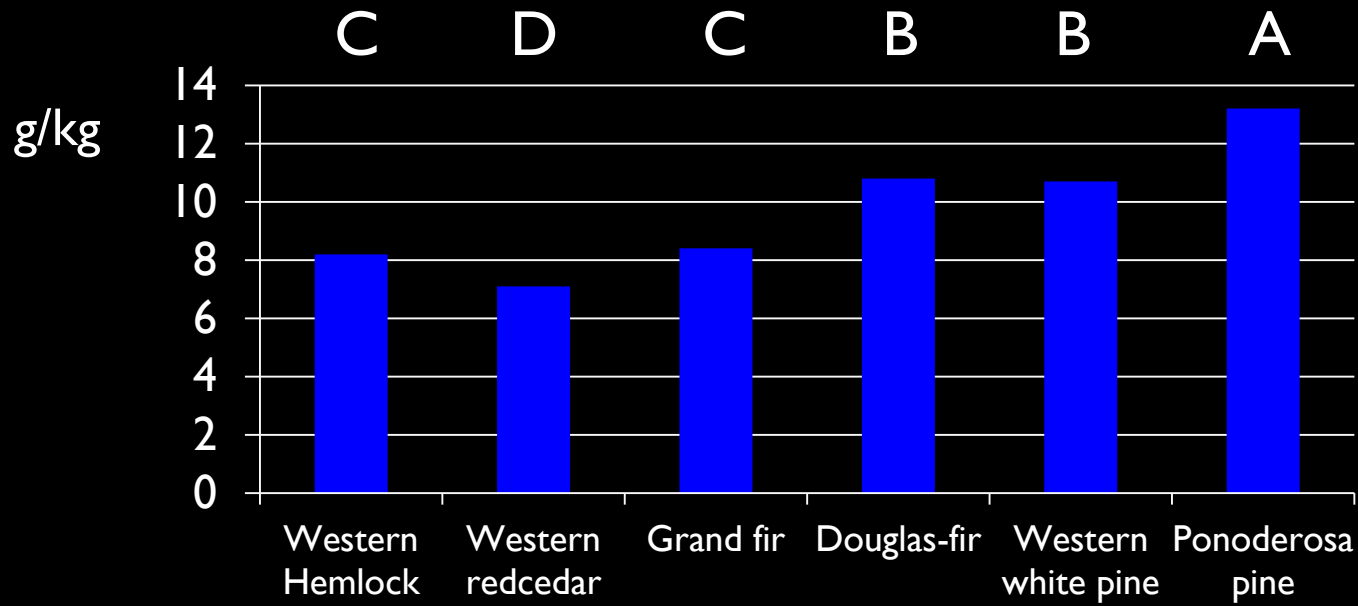


- WP-Western white pine
- PP-Ponderosa pine
- GF-Grand fir
- DF-Douglas-fir
- WRC-Western redcedar
- WH-Western hemlock









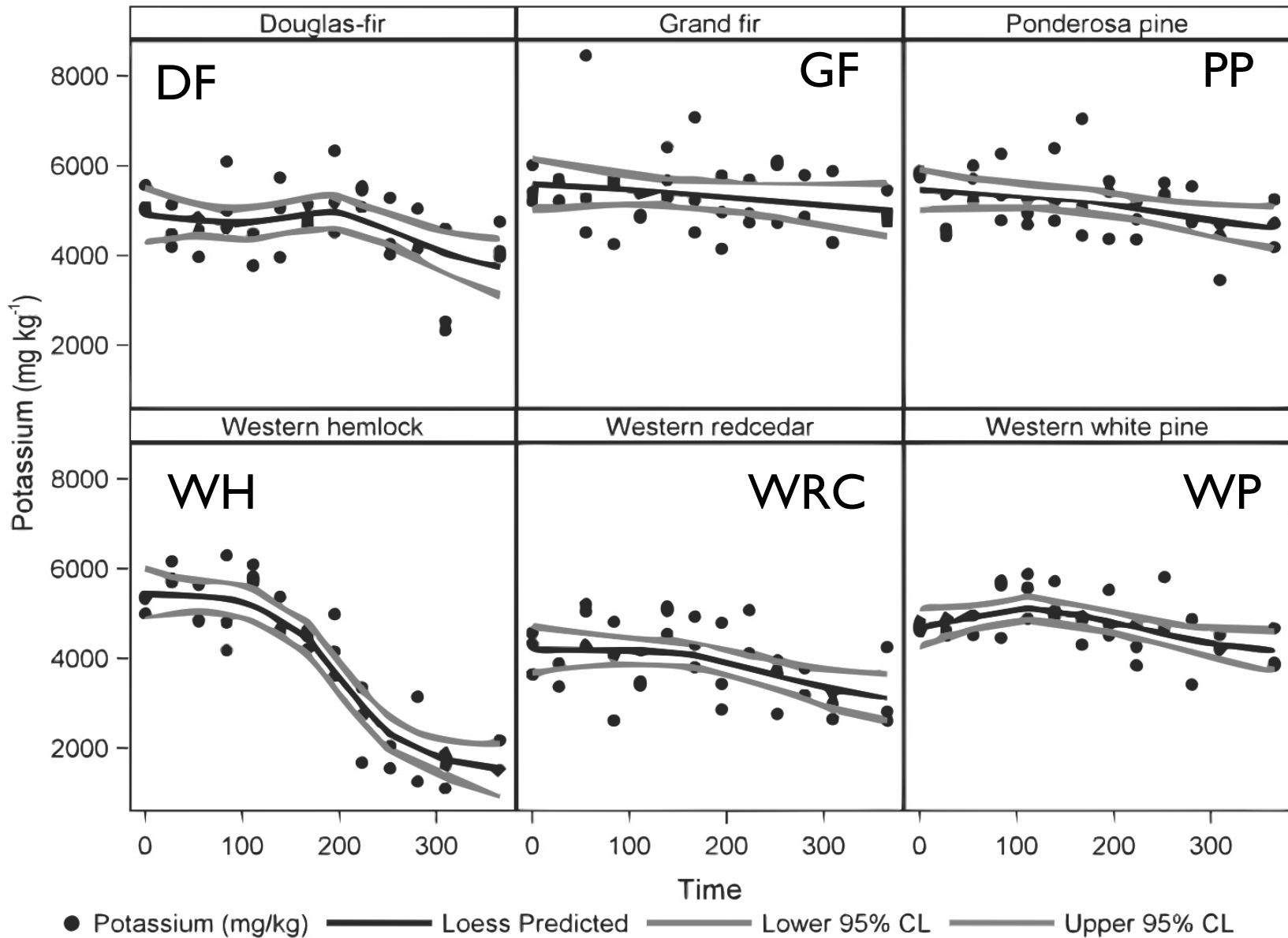
Differences in Concentrations Over Time

Nutrient	Time	Time by Species
Magnesium	0.0005	0.0001
Potassium	<0.0001	<0.0001
Calcium	0.1917	0.4998
Nitrogen	<0.0001	0.0016
Carbon	<0.0001	0.0841

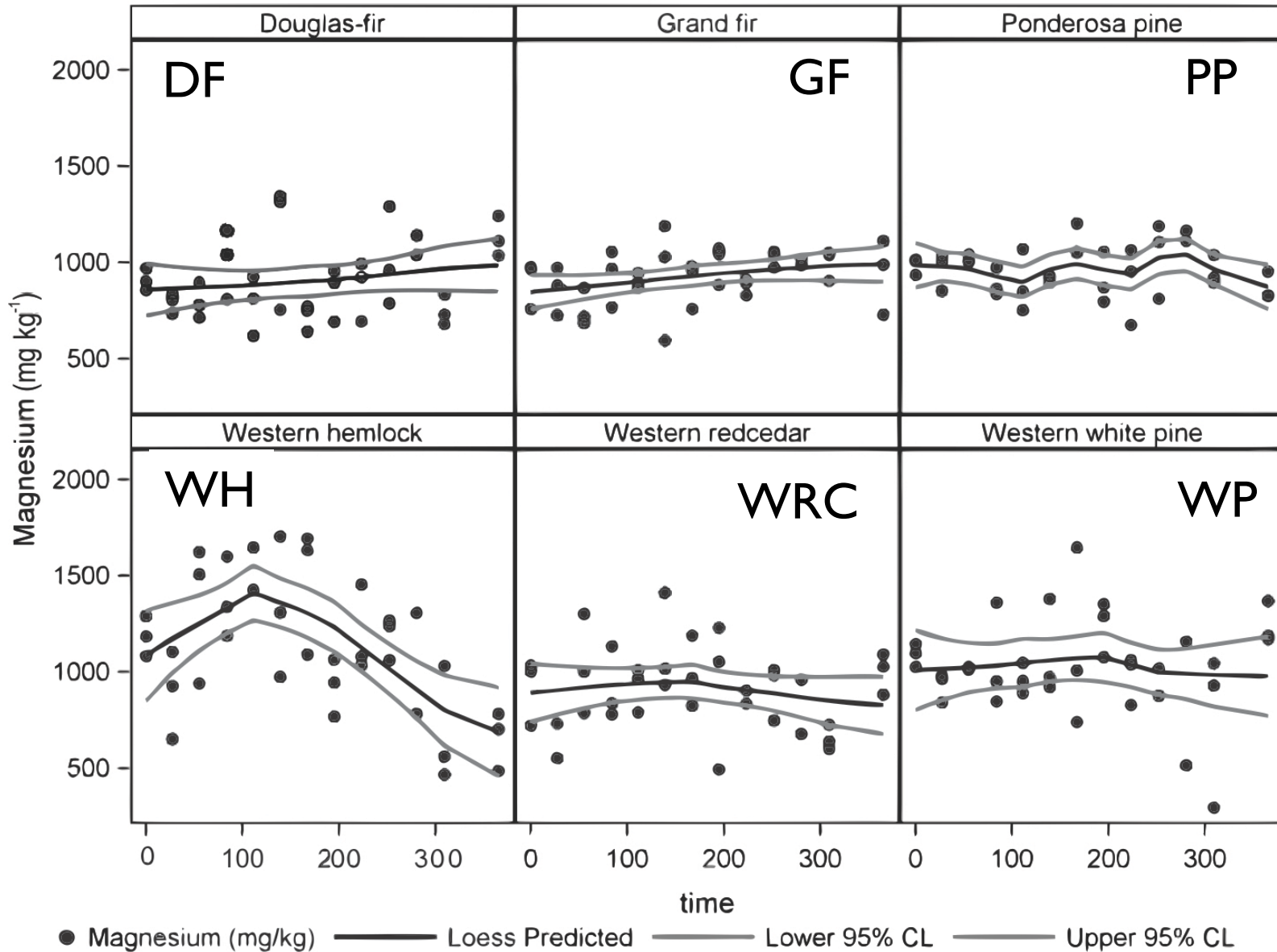
Carbon-to-nutrient ratios not significant

Mixed general linear model with repeated measures

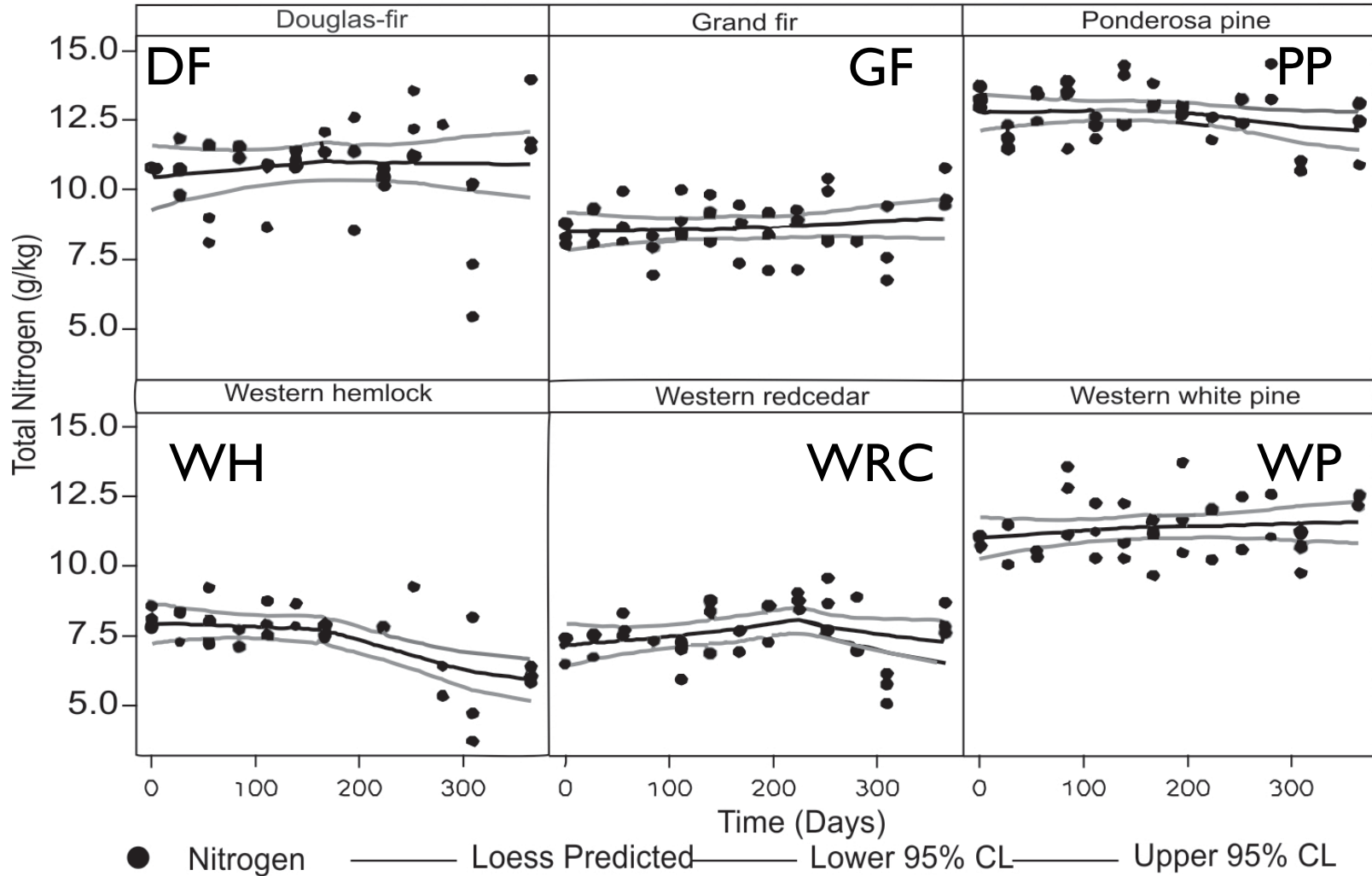
Potassium (mg/kg)



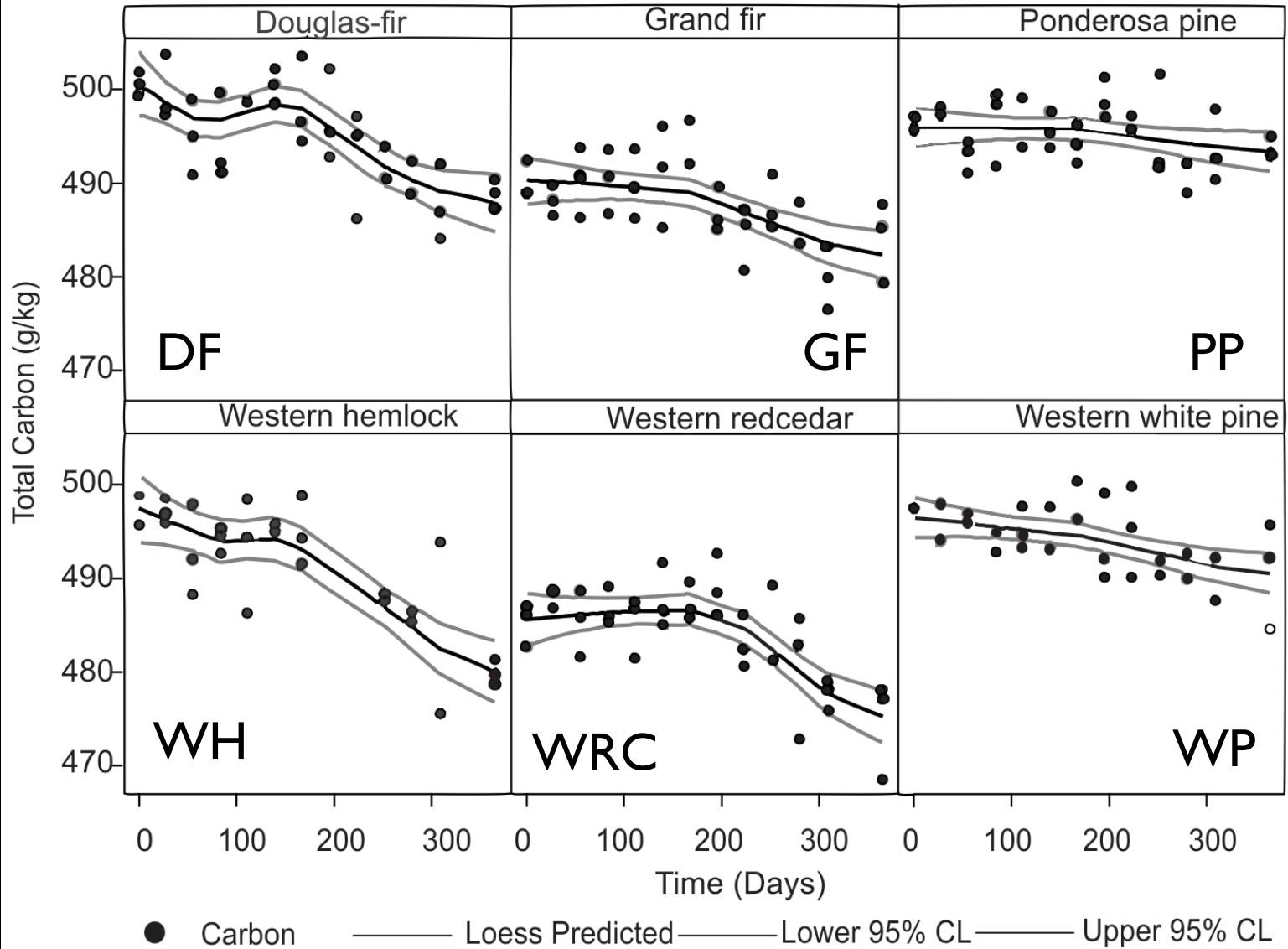
Magnesium (mg/kg)



Nitrogen Concentrations (g/kg)



Carbon (g/kg)



Nutrient Removal



Remove up to
98% of biomass

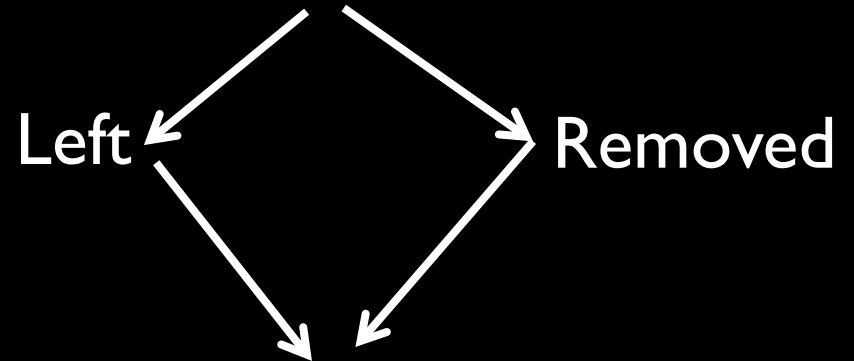
Limiting nutrient

Species

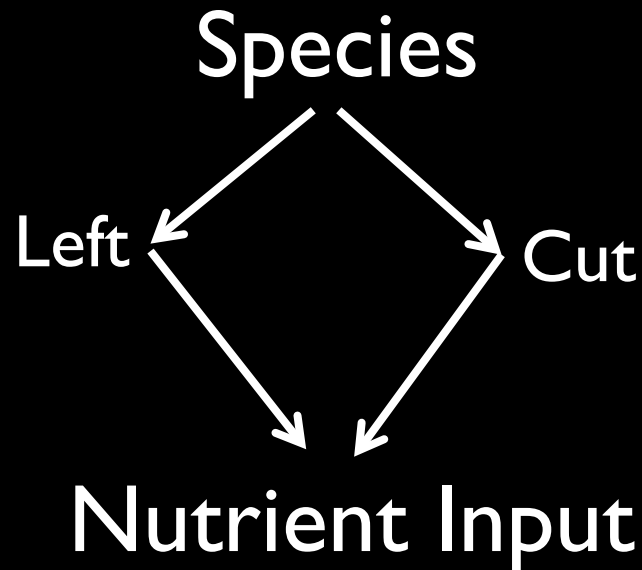
Left

Removed

Biomass thresholds



Organic Fertilizer



Summary

- Nutrients vary by species, site, size
- Nutrient specific rankings vary among species
 - May change from site to site?
- Up to 98% of biomass is removed in cleanings/weedings/thinnings
- Ponder the consequences

Ponder the Consequences

- Soil organic matter
- Nutrient input from other vegetation
- Past harvesting methods
- Objectives
 - Species
 - Alternative treatments – fertilization

What is Next

(If I had all the money in the world)

- Quantify small wood biomass by species
(Growth and Yield Cooperative U of M is dabbling)
 - Across a soil productivity gradient
 - Age: 10 to 50 years
- Develop biomass thresholds
 - Identify sites to vary biomass
 - Quantify growth
- Sub-sample nutrients
- Tree physiological look



Questions
Or
Comments?